THE USE OF NOAA/AVHRR REMOTELY SENSED DATA FOR FIRE MONITORING IN NICARAGUA

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ABSTRACT

The Nicaragua Land Resources (Fire) Monitoring Project is an environmental monitoring project carried out by the *Ministerio del Ambiente y los Recursos Naturales* (MARENA) and the Natural Resources Institute (NRI). This project was supported by the UK-Government Department for International Development (DFID) from June 1995 until June 1998. Since its installation at MARENA headquarters in Managua in 1995, a PC-based NOAA satellite receiving ground station has enabled daily observations to be made on active fires in Nicaragua and Central America. These observations are particularly used to assist and support operational forest management activities in Nicaragua. The poster presents the most relevant findings of the project, with reference to forest fire monitoring in Nicaragua during three recent dry seasons (January-May, 1996 to 1998). The poster illustrates how, within the context of existing forest fire and natural resources management, Nicaragua now has a cost-effective technology to demonstrate the scale and nature of the problem and to adapt its policies accordingly.

FIRE CONCERNS IN NICARAGUA

Monitoring forest fire conditions is essential for the sound management of Nicaragua's important areas of forest resource and for the rational allocation of limited resources to meet fire threats and outbreaks (Figure 1). Nevertheless, until recently, the available information on the occurrence, extent and impact of fires was limited in quality, quantity and timeliness. This presented a major handicap to forest management (Ciesla, W. 1997). While comprehensive analysis of fire data can improve understanding of fire activity and enable better management decisions to be made, such an approach may be a real challenge for a budget constrained government.

Figure 1. Wildfire in the rain forest (Nicaraguan Atlantic region).

FIRE MONITORING THROUGH A LOCAL NOAA SATELLITE DATA RECEPTION SYSTEM

The UK Department for International Development (DFID) supported an environmental monitoring project carried out by the Nicaraguan *Ministerio del Ambiente y los Recursos Naturales* (MARENA) and the Natural Resources Institute (NRI). Since August 1995, a PC-based NOAA satellite receiver installed at the MARENA headquarters in Managua (Figure 2) has

Figure 2. NOAA data receiving antenna.

enabled daily real-time observations of vegetation fires and vegetation greenness status in Nicaragua and elsewhere in Central America. This information is used to assist forest protection, fire control and natural resource management activities on an operational basis (Downey, I. 1997).

Active Fire Detection

Measurements provided by the thermal infrared channels of the AVHRR sensor on-board the NOAA polar satellites are used to detect fire in vegetation through the effect of combustion on radiative temperature. The actual detection of fires is made through a contextual algorithm, which extracts and selects the 'hot' pixels that are most likely to be active fires (Flasse, S. 1996). Note that, in a NOAA/AVHRR image, a pixel corresponds to approximately 1.1 km^2 of actual territory. An example is shown in Figure 3.

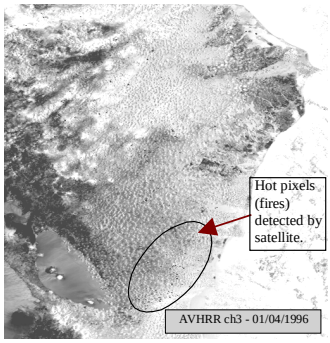

Figure 3. Typical NOAA/AVHRR image from which active fire are detected.

Fire Data Distribution

Daily fire locations are generated on a routine basis and supplied to a number of counterpart institutions in Nicaragua as well as in other Central American countries. The NOAA unit in MARENA has become the main fire detection data provider for the whole of Central America (Figure 4). Many people, including relevant managers of different Nicaraguan institutions, visitors to the project, and most attendees in recent regional workshops or conferences about fire issues recognise its national and regional relevance.

Fire Data Analysis

At a national or local scale, the data are analysed in their context (land cover, forest type, administrative divisions, protection status, population and rural population density) by using a GIS, to provide thematic information which can be used for example to locate possible deforestation fronts, helping to raise political awareness, or to direct extension programmes to promote adequate strategies, such as alternative land use.

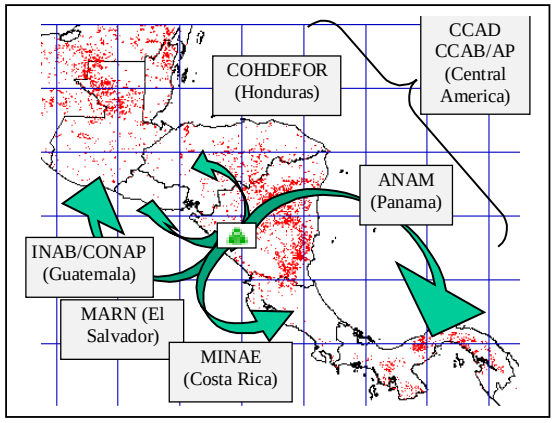

Figure 4. Data distribution from MARENA to Central American counterpart institutions.

A SURVEY OF THREE SUCCESSIVE FIRE SEASONS

The rate of valid data captured varies slightly over months and years. In order to compare data from different seasons, the monthly and seasonal figures, as shown in Table 1, are weighted. The numbers of hot pixels are divided by the respective numbers of days of actual data capture and multiplied by the total number of days in every month.

Fire activity can show a different pattern in each season. It began rather early in 1996 and rather late in 1997. Unusually, in 1997, most of fire activity occurred in May. 1998 has been the most dramatic year in terms of fire occurrence by far.

In Nicaragua, most of fire activity occurs during the dry season, which stretches from the end of December up to the end of May. Three successive seasons were monitored by the project (1996 to 1998).

Time series detected fires maps usually show a typical West-to-East movement of fire activity in Nicaragua. The earliest fires (in January and even December some years) are generally observed only in the pacific region (the driest, most densely populated and most intensively farmed region of the country). Two months later, the central mountain region begins to suffer outbreaks of fire activity. Toward April, fire activity invades the rest of the country and especially increases in the Atlantic region, although this has the lowest population density and the wettest climate.

	January	February	March	April	May	Total Season
1996	509	799	2,233	8,176	432	12,150
1997	210	375	775	6,883	7,071	15,314
1998	293	651	2,919	16,829	3,422	24,114

Table 1. Weighted numbers of detected hot pixels.

The 1998 season, as displayed in Figure 5, showed an outstanding fire activity throughout the country and even the whole of Central America. There is a likely cause-effect relationship with the exceptional level reached by *El Niño* phenomenon in late 1997 to early 1998, which induced a very severe and long drought (WFP 1998).

Figure 5. Time series of monthly detected fires maps for the 1998 season.

CONCLUSIONS

The work described here has led to a greater appreciation in Nicaragua of the relevance and practicality of low cost, satellite-based remote sensing as a tool to assist monitoring and evaluating forest fires. As a result, a small scale remote sensing unit is now established and managed on a routine basis in MARENA for the benefit of forest managers and local or national decision making bodies.

Results from three complete seasons clearly indicate fire incidence, severity and variation over time and between different regions. This technology and the methods described for monitoring fire are seen to have a wider international application.

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